GEOS Integrated Earth System Analysis: Preliminary Results With Atmosphere-Ocean Coupling

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CERES Sc Team Meeting
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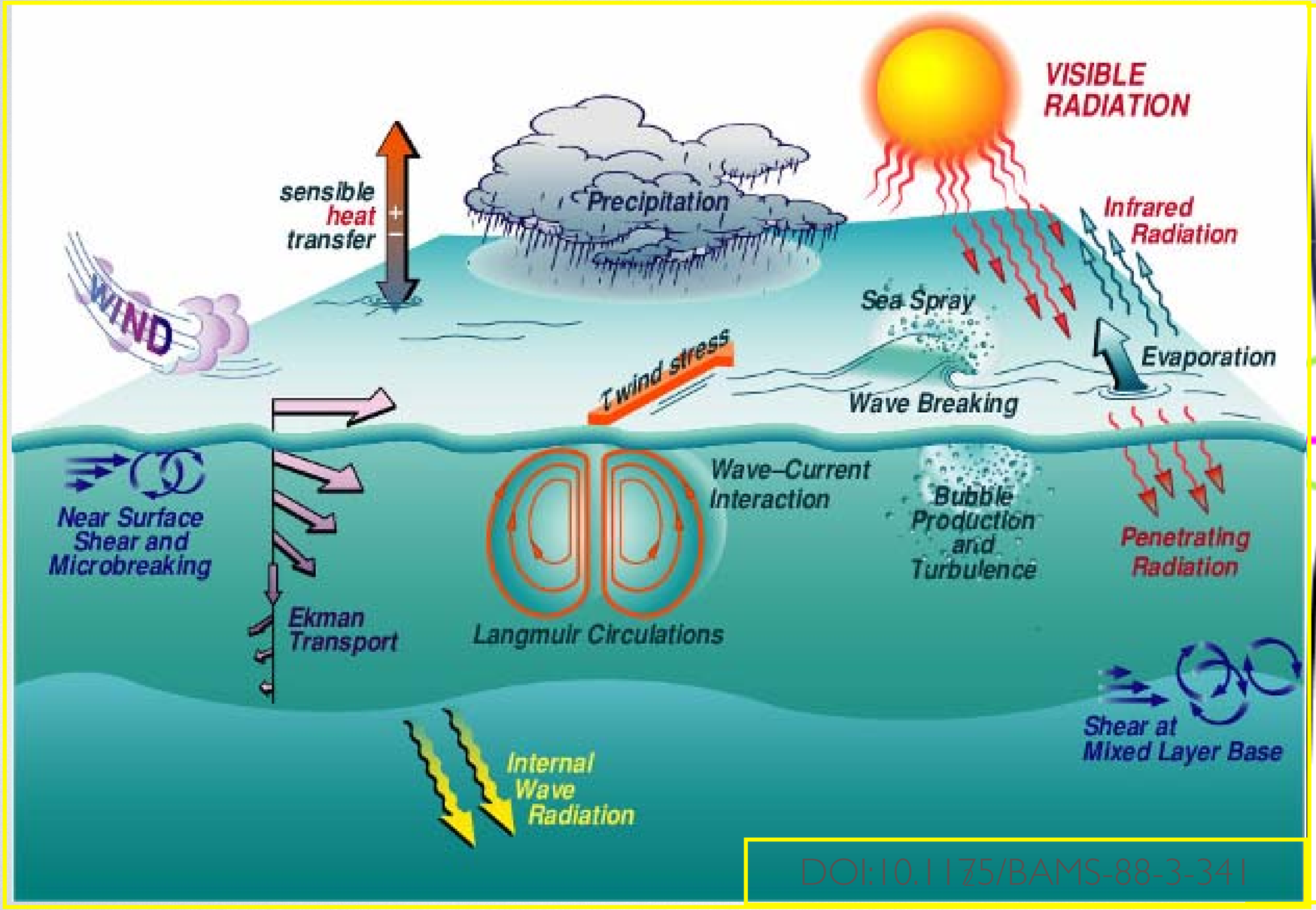
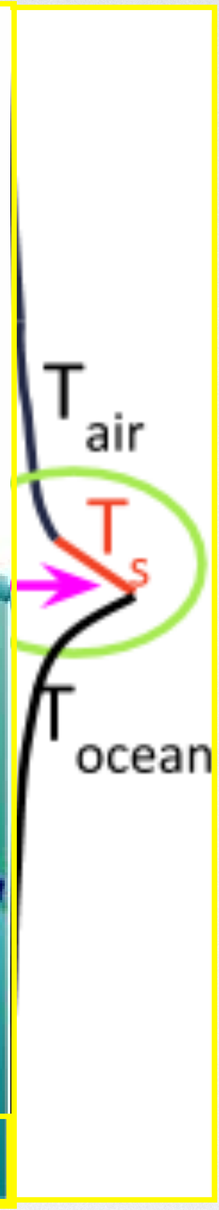
COUPLED PROCESSES



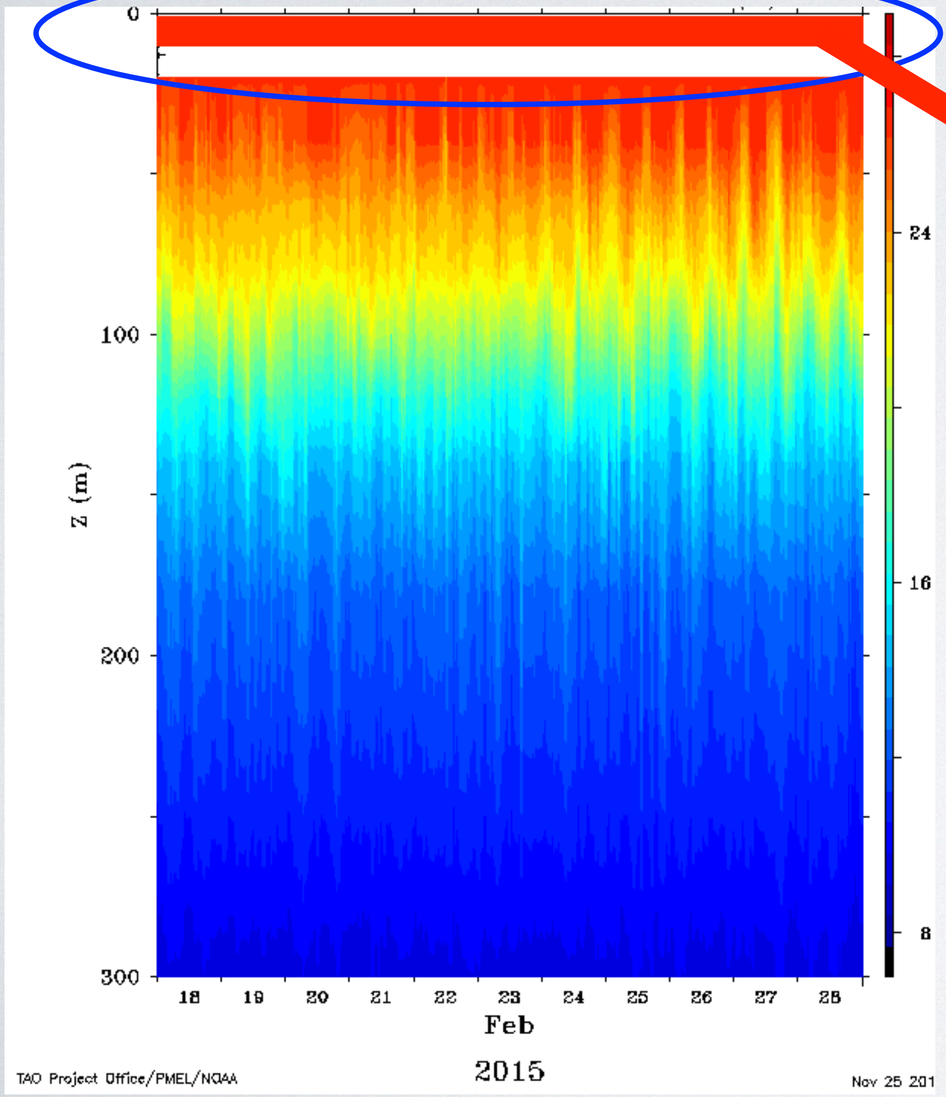


GEOS-Data Assimilation System

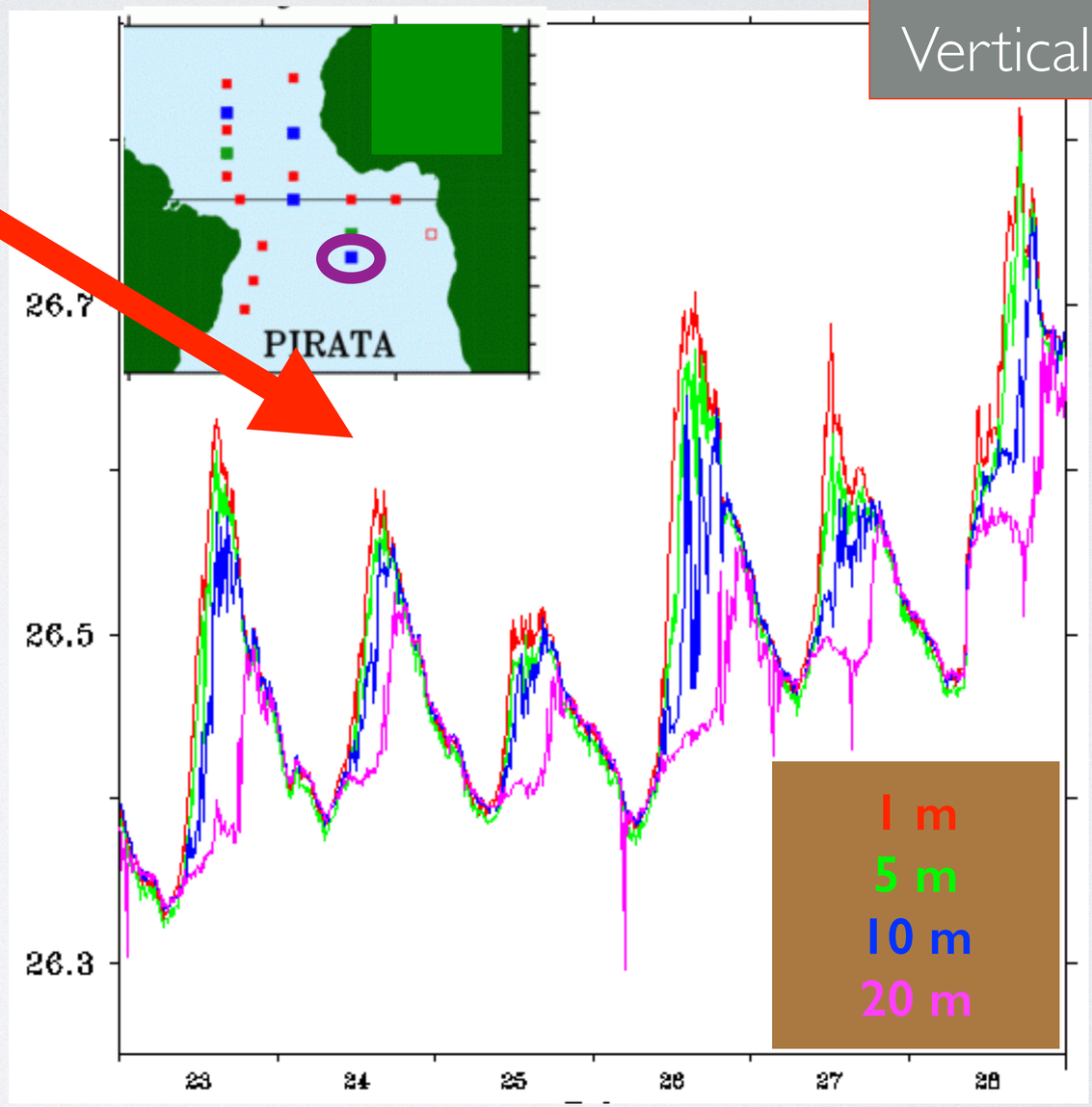
- **Atmospheric DA System** (e.g., MERRA-2)
- **Uncoupled**: SST & Sea-Ice concentration from Retrievals

COUPLED PROCESSES: UPPER OCEAN VARIABILITY

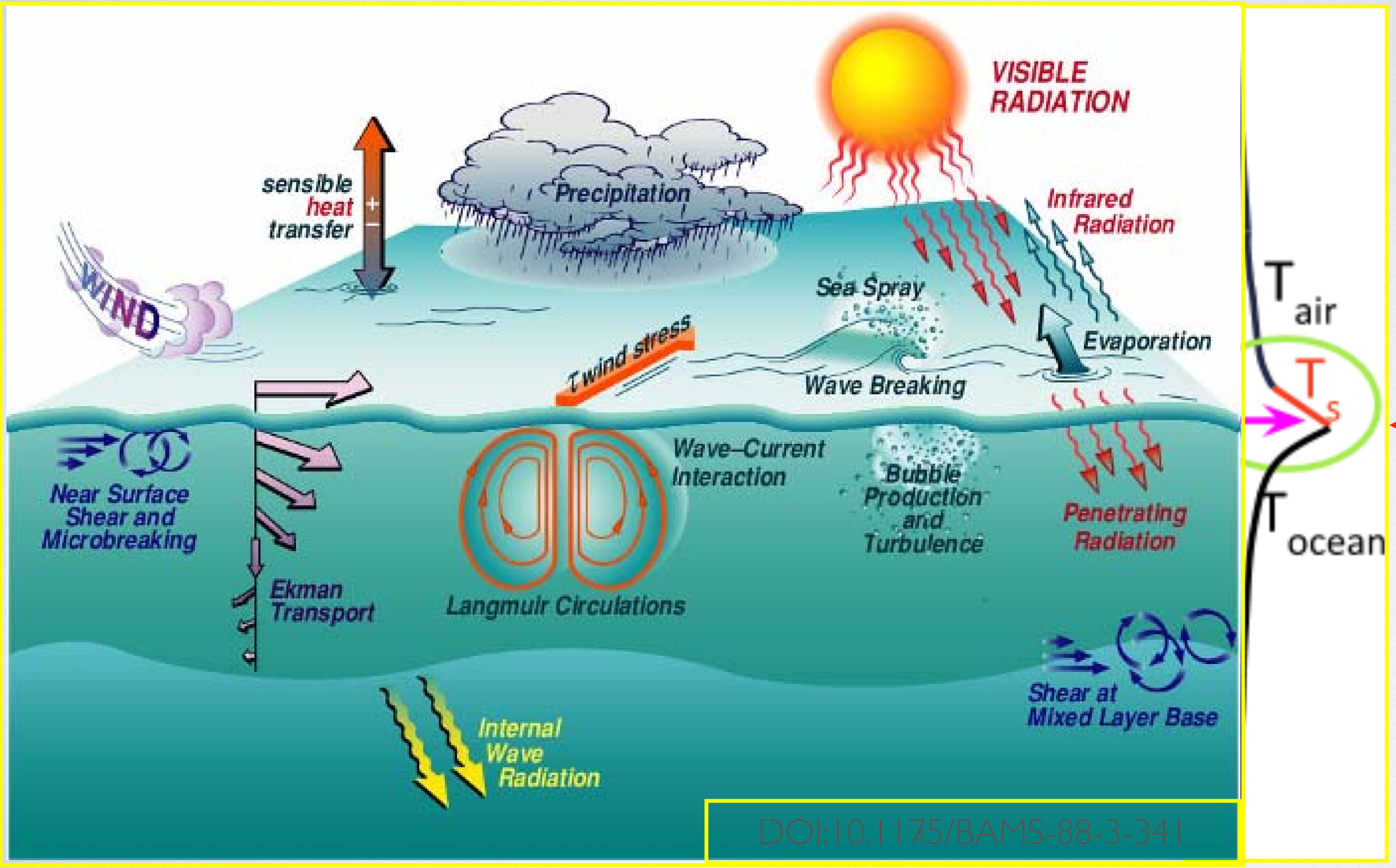
Isotherms (°C)
[10S, 10W]



Diurnal Warming
Vertical Stratification



Air-Sea Interface

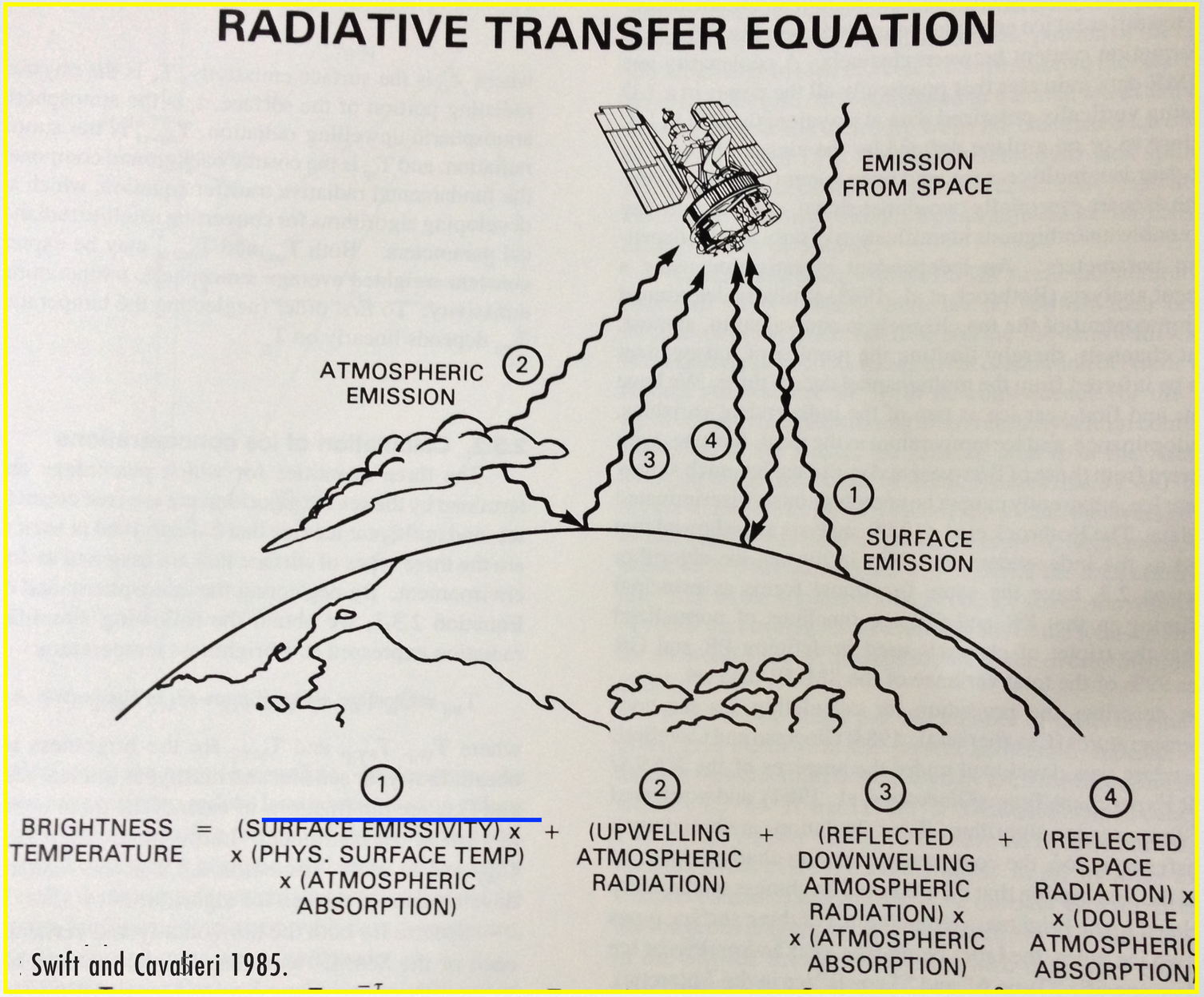


Skin
SST (T_s)

SKIN SST

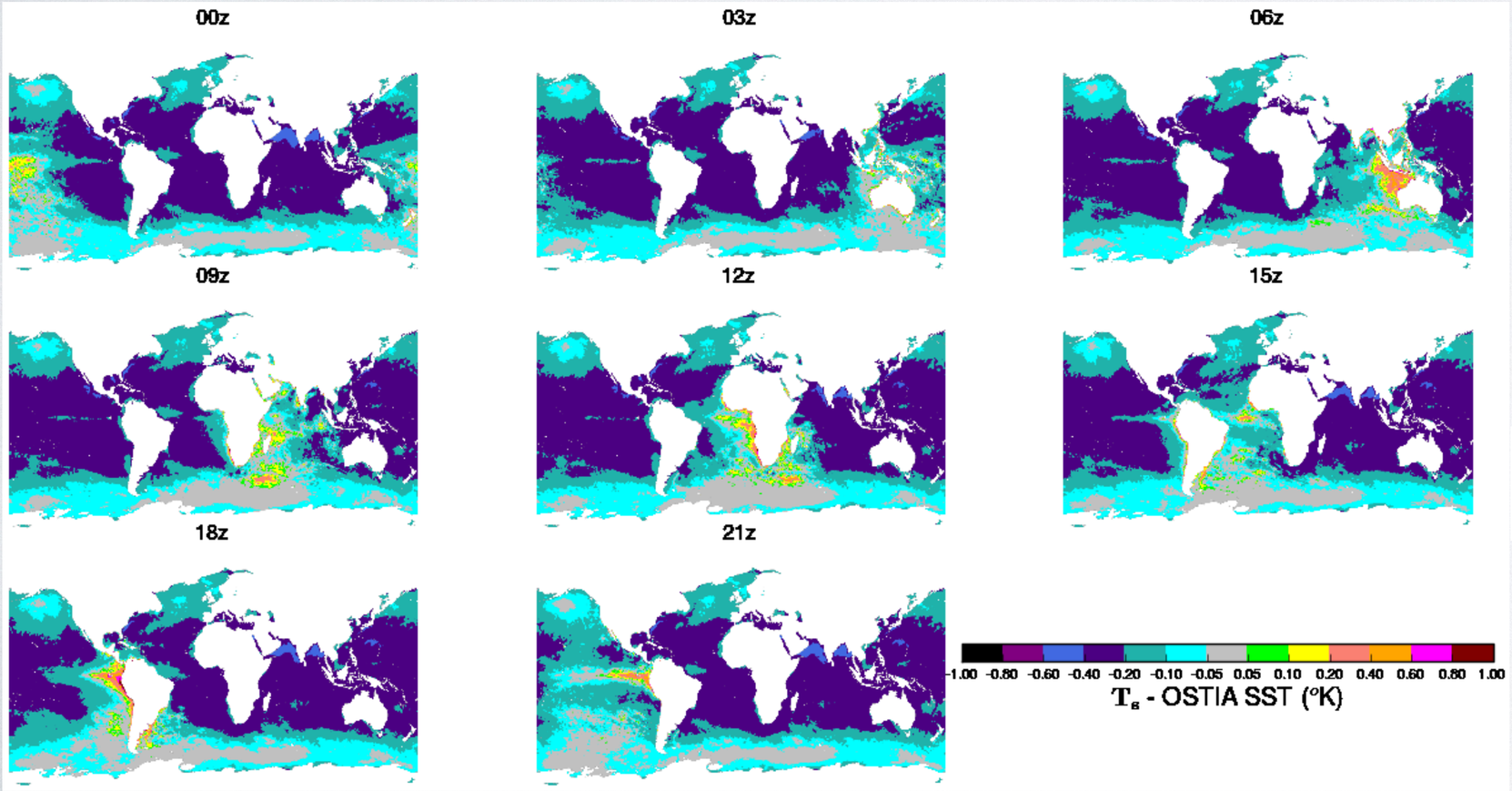
Needed for:

- **Satellite retrievals** (sea-ice, water vapor, …)
- **Data Assimilation** of Satellite **radiance observations**
- **Air-sea** heat and momentum **exchange**
- **Gas exchange** : pCO_2, …



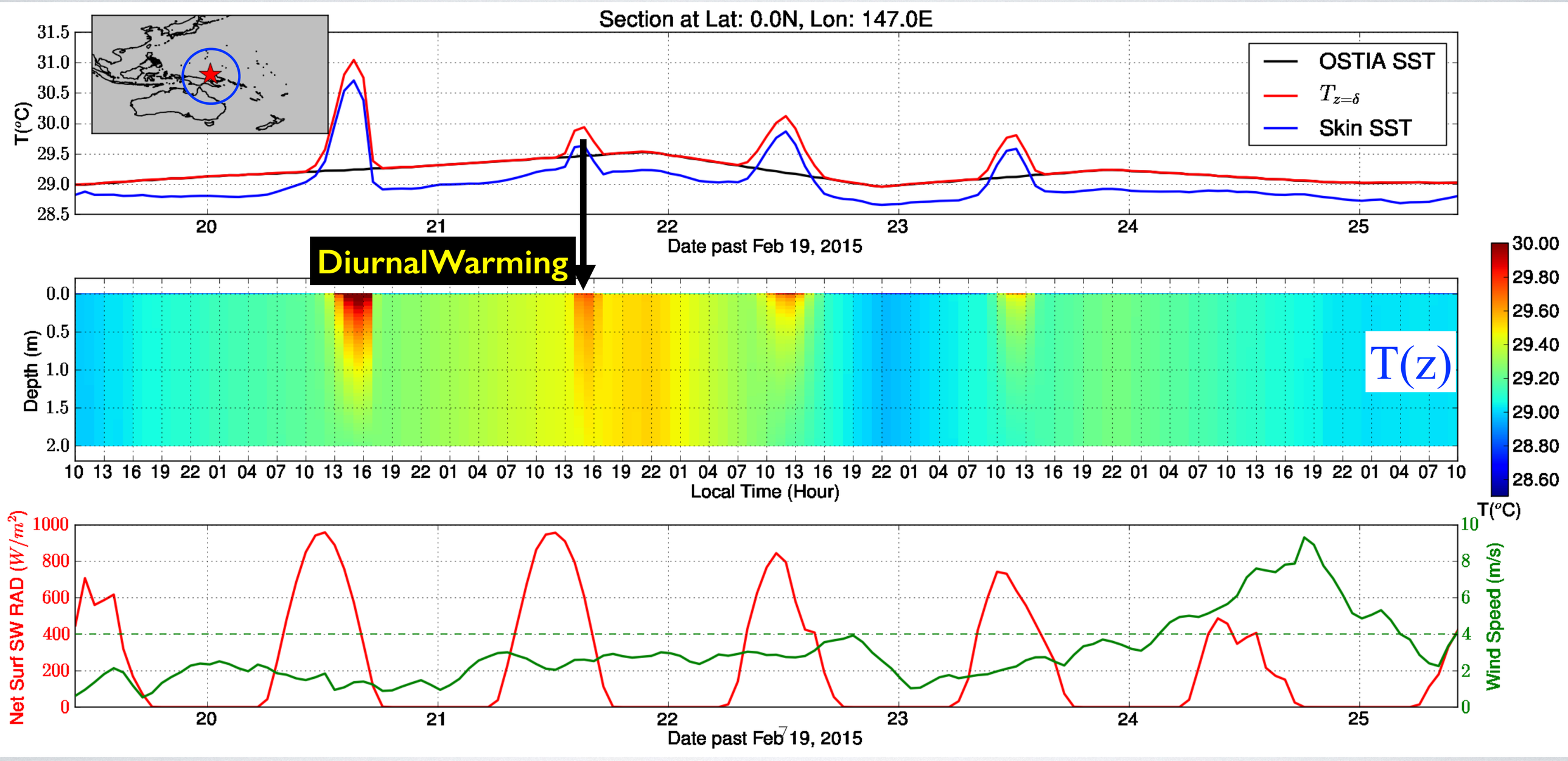
GEOS-ADAS: Skin SST

- ☑ **thermally stratification** due to diurnal warming
- ☑ a thin **cool-skin layer**
- ☑ **Directly assimilated radiance observations** (**IR**) which *measure* Skin SST



Feb, 2015
monthly mean
Skin - OSTIA SST (°K)

GEOS-ADAS: NEAR-SURFACE THERMAL STRATIFICATION



GEOS-ADAS: SKIN SST

Further details…

- Akella et al., 2017, "Assimilation for skin SST in the NASA GEOS atmospheric data assimilation system". Q.J.R. Meteorol. Soc. doi:10.1002/qj.2988

- C Gentlemann and S Akella, 2017, "Comparison of NASA GEOS-ADAS diurnal warming to SEVIRI and AMSR2 retrievals". Accepted with major revisions, JGR Oceans.

- GMAO Tech Memo., Vol.44: https://gmao.gsfc.nasa.gov/pubs/docs/Akella873.pdf

GEOS-DAS: ATMOSPHERE-OCEAN COUPLING

Ocean Components:

- GFDL MOM-5 ocean GCM coupled to the GEOS AGCM
- An ensemble based ocean analysis

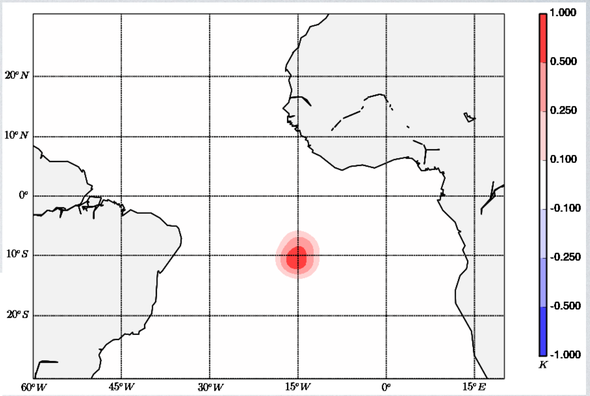
Separate atmosphere & ocean analyses

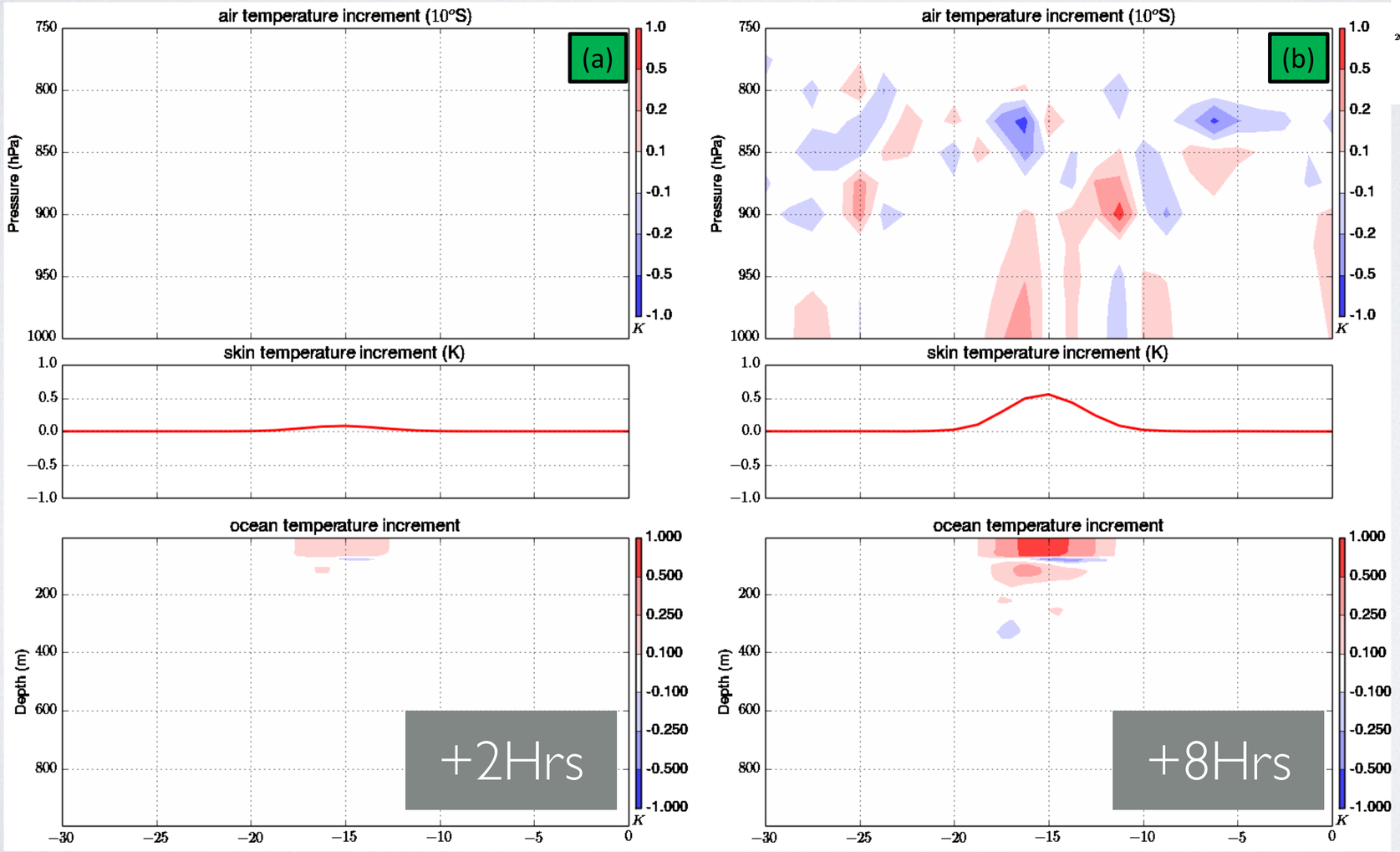
- Latency of ocean observations
- Slower time-scale of (deep) ocean
- Direct assimilation of satellite radiance observations requires surface-ocean; not so much the deep ocean

GEOS-DAS: ATMOSPHERE-OCEAN COUPLING

Preliminary Results: Ocean

- A single temperature observation (10S, 15W, -10M)
- increment of 0.75C

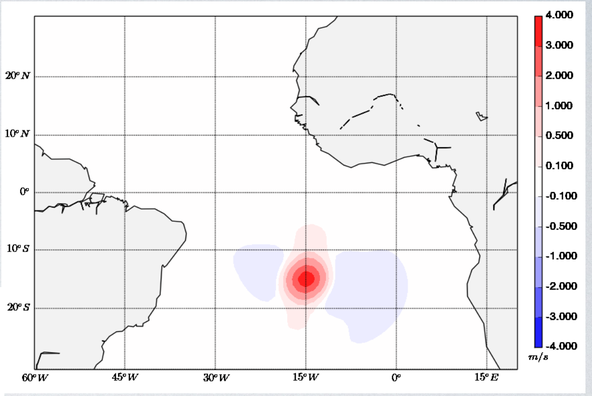


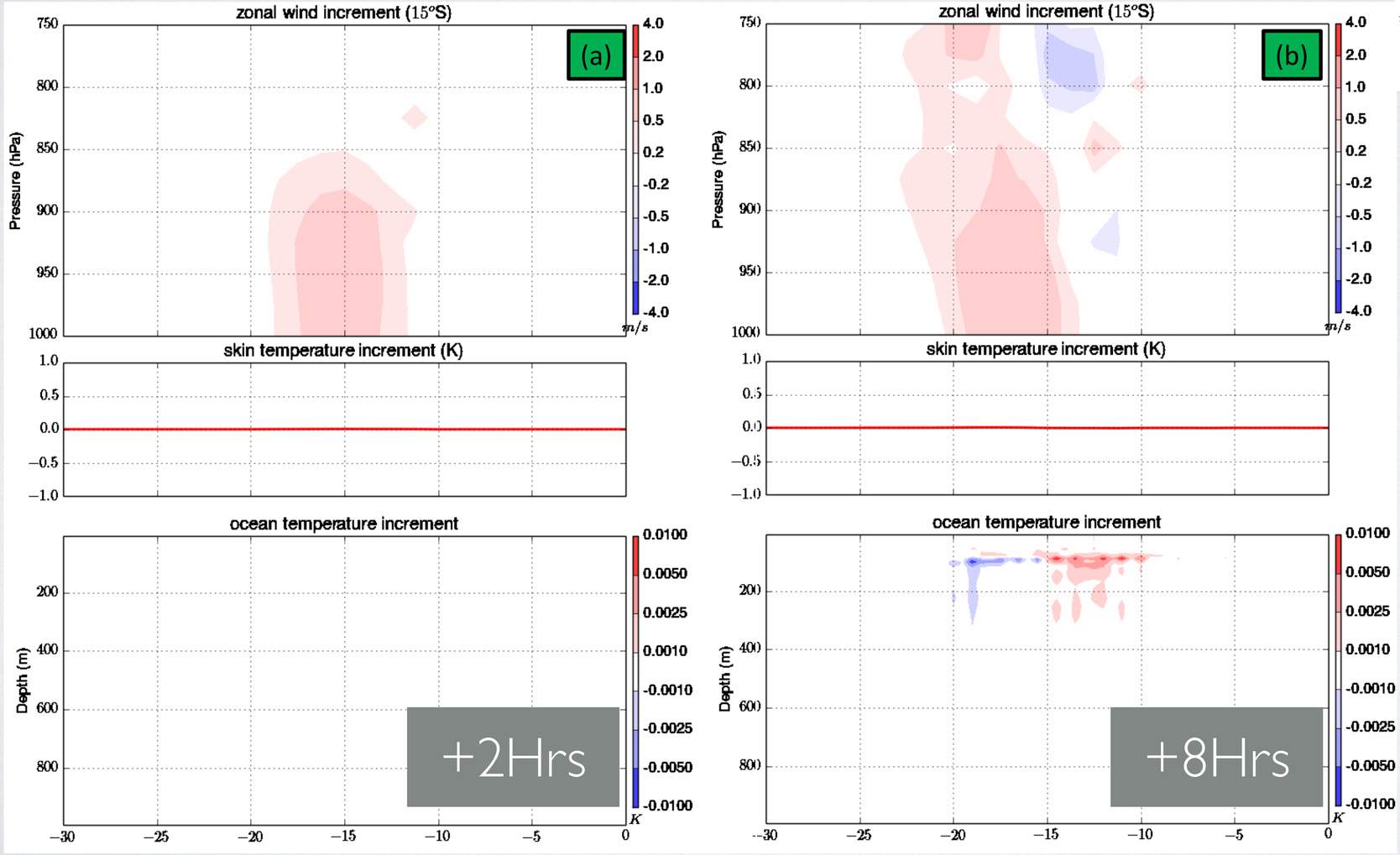


GEOS-DAS: ATMOSPHERE-OCEAN COUPLING

Preliminary Results: Atmosphere

- A single wind observation (15S, 15W, 950hPa)
- increment of 5 m/s





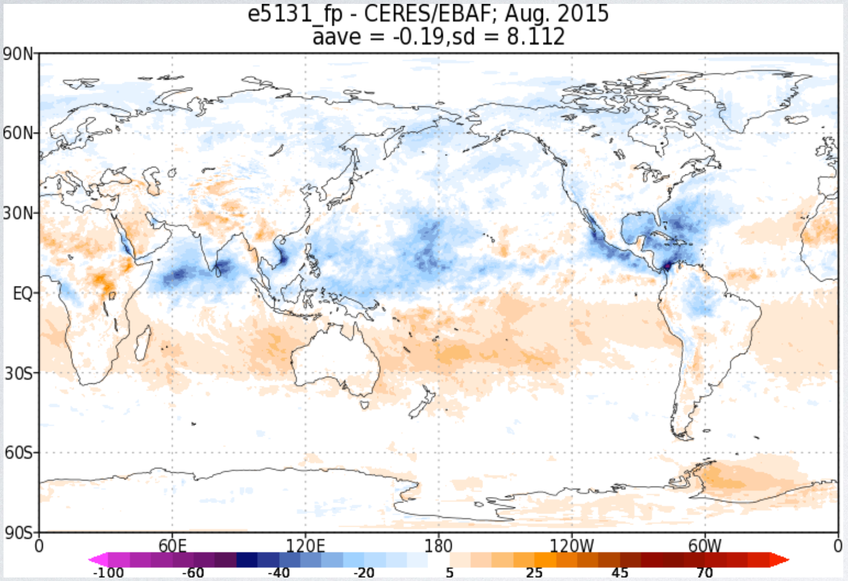
SUMMARY

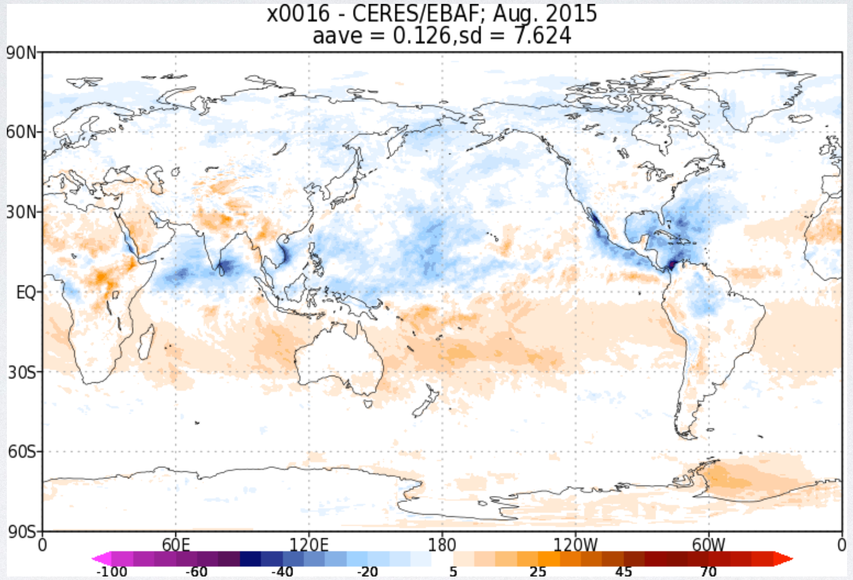
- GEOS DAS assimilates Skin SST using radiance observations
- Atmosphere-only to a Atmosphere-Ocean Coupled Data Assimilation System
    - ✳ Coupled AO-GCM
    - ✳ Coupled atmosphere and ocean analyses
- Preliminary results show cross-component observational feedback

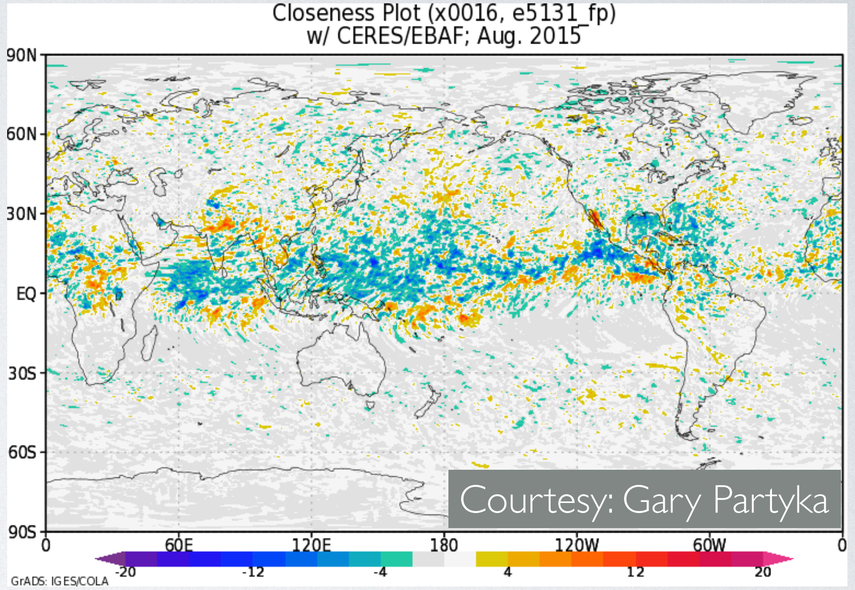
Questions, Feedback, Suggestions
Thank You!

AIR-SEA FLUXES: OLR DIFFERENCES

with CERES/EBAF (Aug, 2015)



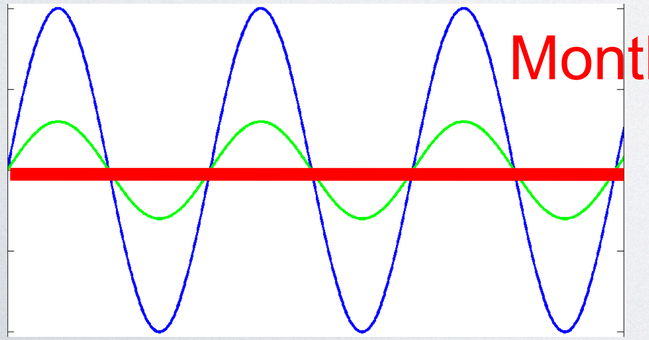




No Skin SST Analysis

With Skin SST Analysis

Absolute Difference



Need DIURNAL validation… however few oceanSITES locations and *not* NRT.